

An

Inaugural Dissertation

Read March 1825

on

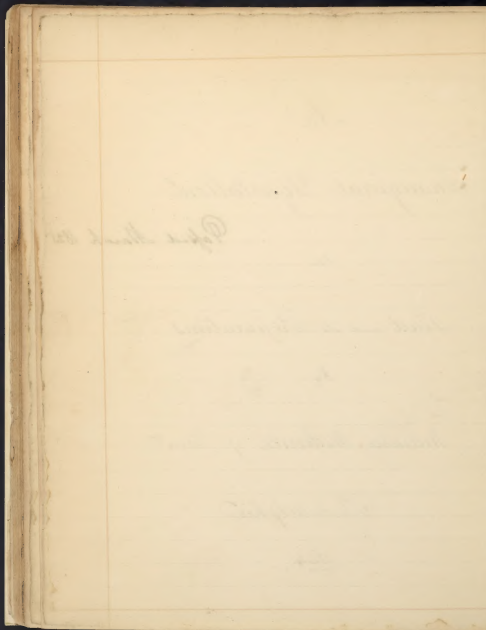
Lead and its Preparations

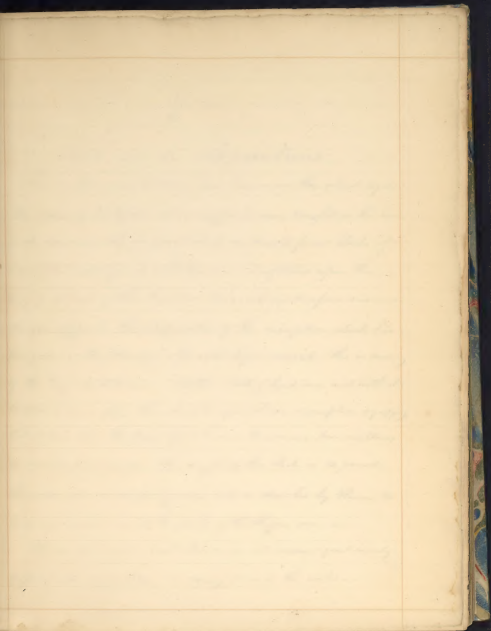
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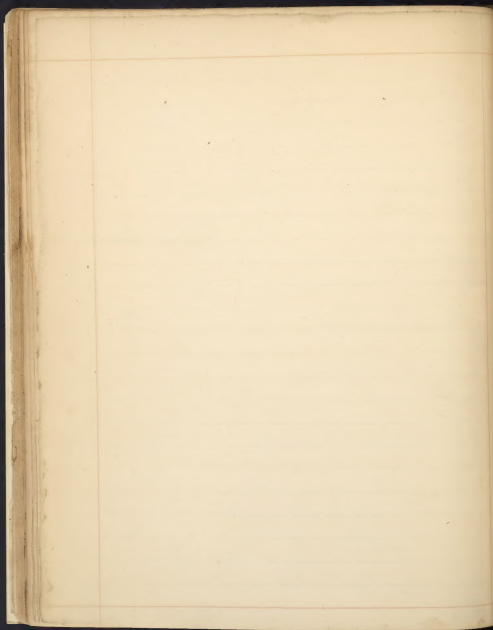
William Wetherill of Penn<sup>a</sup>

Philadelphia

1824  
— " —





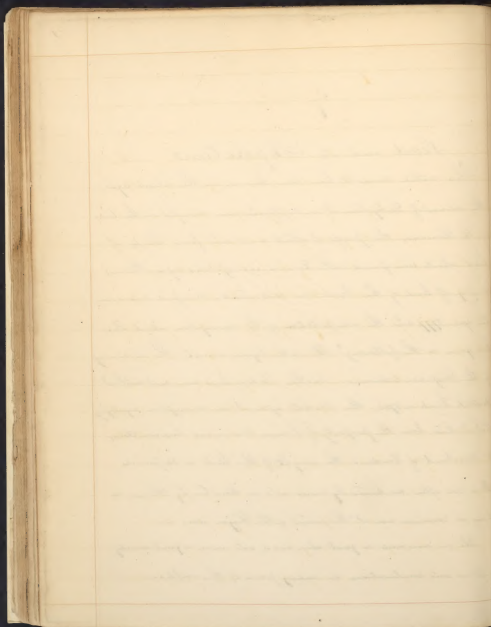


Of

## Lead and its Preparations

This metal seems to have been known in the earliest ages; the mines of Derbyshire it is supposed were wrought in the time of the Romans, the proofs of which are derived from blocks of lead which were found with Roman inscriptions upon them: a pig of lead of this kind was discovered on Cornford moor in the year 1777 and the interpretation of the inscription which has been given is the following "The sixth legion inscribe this in memory of the Emperor Adrian. Another block of lead was met with at Maltby bank in 1783, this also had upon it an inscription signifying that it had been the property of Lucius Annovius Severinus, a merchant of London: the weight of this block is 84 pounds. It is also often mentioned by poets and is described by Homer, as being in common use at the period of the Trojan war. —

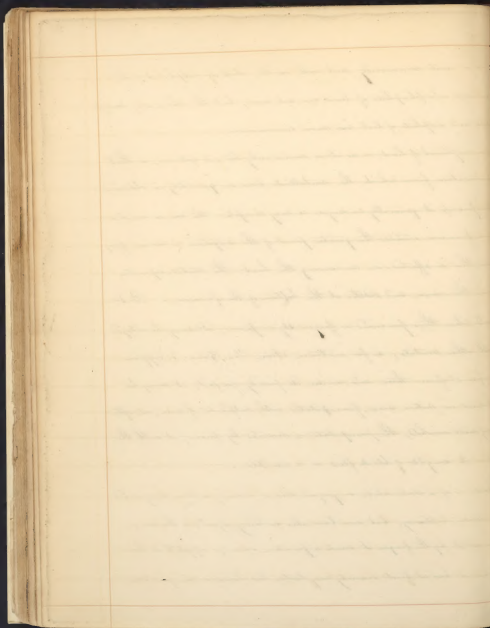
The ore now exists in great abundance and under a great variety of forms and combinations, in many parts of the world. —



It is most commonly met with in the state of sulphuret; the carbonate and phosphate of lead are not rare, but the chromate, molybdate and sulphate of lead are more uncommon.

The sulphuret of lead, or as it is commonly termed galena, is that combination from which the metallic lead in quantity is obtained. The process it generally undergoes is very simple: the ore is roasted in a furnace until the greater part of the sulphur is driven off; after this is effected, on increasing the heat, the metal separates from the scum and settles at the bottom of the furnace. But lead when thus procured is frequently impure, it may be alloyed with other metals, as for instance Iron, Tin, Zinc, or Copper: to free it from these and render its purity perfect, it may be dissolved in nitric acid, precipitated with sulphate of soda, and after being well washed, the precipitate is reduced by fusing it with three times its weight of black flux in a crucible.

Lead, is of a dull white or grayish colour, having a blue tinge and considerable brilliancy, but soon tarnishes on being exposed to the air; when rubbed by the finger it emits a peculiar odour; applied to the tongue it has at first scarcely any taste, but leaves a disagreeable

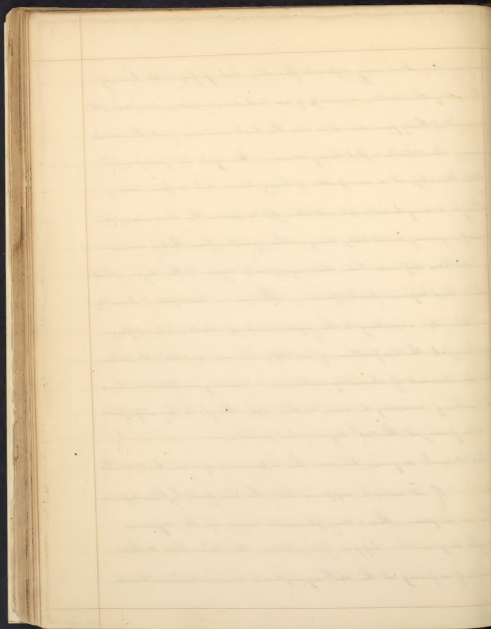




compressible; it is very soft and flexible, but possesses less tenacity than any other metal, a wire  $\frac{1}{16}$  of an inch in diameter, will break with a weight of thirty pounds; it is also the least sonorous of all the metals, giving when struck a flat heavy sound. Owing to its possessing so little tenacity, it is incapable of being drawn into a fine wire; though it may be extended into thin plates under the hammer; its specific gravity is 11.352, being rather greater than that of silver.

Authors differ in their statements, with regard to the degree of heat which lead requires for its fusion; Thomson in his system of chemistry mentions it, according to the experiments of Mr. Chrichton of Glasgow as being at the temperature of  $652^{\circ}$  F<sup>h</sup>; Berardus, says  $600^{\circ}$ , & Miller in his elements of chemistry published at Edinburgh in 1829, mentions it as being according to some authors  $594^{\circ}$ , though he himself speaks of it as fusing at the  $540^{\text{th}}$  degree of Fahrenheit.

But I would enquire, how can this difference of opinion be accounted for? If it could be supposed that the lead fused by these experimenters was impure, then a very plausible reason for the difference might be given. Suppose for instance the lead which Dr. Miller speaks of as fusing at the  $540^{\text{th}}$  degree, should have contained a small



portions; but the rising point of about inch or 442) this material would  
have reached a sufficient thickness for notwithstanding the extreme degree  
of heat which it requires for fusion, it is known that two parts of  
lead and one of tin form an alloy, more fusible than either metal alone.\*  
From this fact it would appear probable, that the admixture of a  
much smaller portion of tin, than the proportion formerly added,  
would decrease sufficiently the degree of heat required to fuse it, to  
account for the difference existing. —

Lead is brittle at the time of congelation. In this state it may  
be broken to pieces with a hammer and the congelation of it in  
least parts, will exhibit an even, smooth of parallel lines. —

When lead is melted in the open air, and left in a state of fusion,  
an incrustation, or skin forms on the surface which gradually changes  
to a uniform green colour. When this pollution is removed another  
'green' will in the way the white lead may be converted into this  
substance. If these pollutions be heated and agitated for a short  
time in an open vessel, they assume the appearance of a greenish  
yellow powder; this colour as Mr. Ponsot has shown is supposed  
to be derived from a mixture of yellow oxide and a portion of lead



in the metallic state. —

If we continue to expose this powder to a heat for  
somewhat longer in an open vessel, it absorbs more  
oxygen, assumes a yellow colour, and is then  
known in commerce by the name of *maspist*. —  
This change is owing to the absorption of oxygen  
by the metallic portion of the drop, converting the  
whole into a homogeneous compound.

This oxide, by being subjected to strong heat in a furnace  
for from about 50 to 60 hours is converted into a red  
powder well known in the arts by the name of *rouge* or *red  
lead*: this is the highest state of oxygenation which can be effected  
by mere calcination; but there is yet another oxide, called the *brown, peroxide*,  
or *flux* colour; this is obtained by pouring nitric acid of the specific  
gravity 1.266 upon red lead; 185 parts of the oxide are dissolved, being in  
the state of a yellow and the remainder is formed into the brown oxide. The  
theory advanced by P. H. Lavoisier is, that the oxide which dissolves during  
its solution, on forming *maspist* affords oxygen to the undissolved portion,  
so as to convert it into the same substance. —



This oxide may be prepared also by passing a current of oxygen under water  
or chlorine gas, through water in which the red oxide is kept suspended, and  
by precipitating it with caustic potash —

From what has been said it appears capable of combining with oxygen in different  
proportions, and those of its combinations with the substance appears to be

three, and distinct bodies; the two containing the lesser proportions of oxygen may be  
formed by heat with the exclusion of air; those when thus prepared constitute maximum  
and minimum. The third which contains the greatest proportion of oxygen requires the  
action of an acid, and from the quantity of oxygen contained in its composition has  
received the name of per oxide. — These substances were carefully in-

vestigated by Berzelius, and according to his statements are composed of  
oxygen and metal in the proportions — as follows

The first or *mesometes* appears to be composed of

Lead	92.85	100.	1298.7
Oxygen	7.15	7.7	1000.

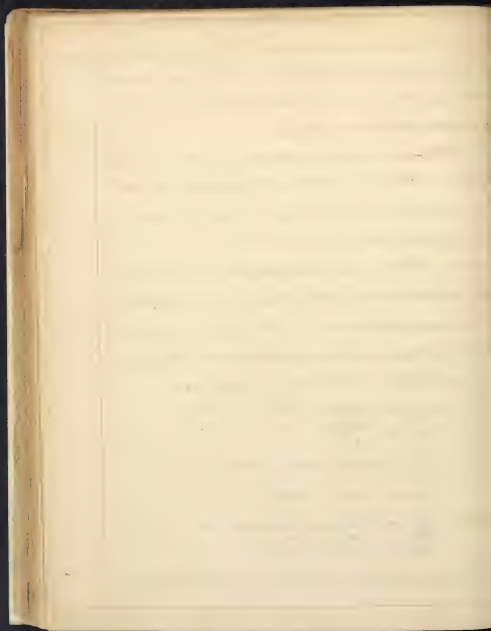
The second or *microetes*, appears to consist of

Lead	90.	100
Oxygen	10	11.08

The third or *per oxide* Berzelius found to consist of

Lead	86.51	100.
Oxygen	13.49	15.6

In combining to produce these results with 100 parts of metal as these three oxides, we





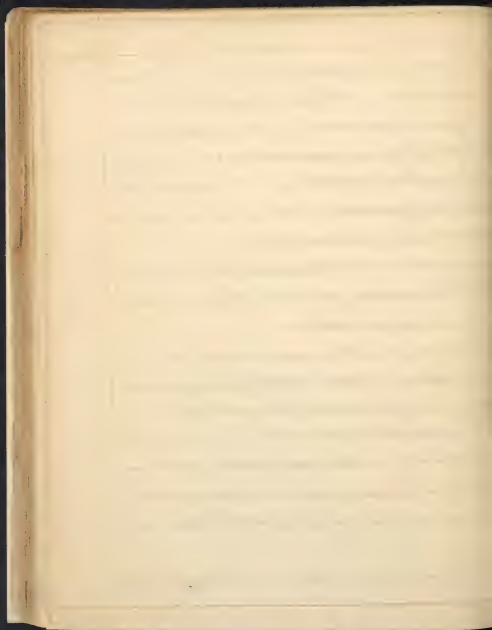
that give the numbers 77, 1100 etc. But are really in the proportion of 1,  $1\frac{1}{2}$  and 2. If therefore multiply these last numbers by 2 we shall have the oxygen of the three oxides of lead respectively by 2, 3, to wit. This view of the subject would render it probable that there exists an oxide of lead, with less oxygen than any at present known. The yellow oxide of lead when precipitated by ferrous sulphate from its compounds forms a white body, the composition of which is not exactly known. —

The oxides of lead are easily reduced, and have the property of uniting with all the metals, excepting gold and silver. Hence gold or silver may be purified by melting them with lead.

The oxides also give up their oxygen on the application of heat. When distilled in an exhausted vessel they afford oxygen gas; when still more readily, when distilled with concentrated sulphuric acid.

The oxides of lead are also reduced by being ignited with combustible matter: thus when a mixture of red oxide of lead and charcoal is ignited in a crucible, a button of metallic lead will be found at the bottom of the vessel.

Iron scales, has no direct action on lead; but it facilitates the

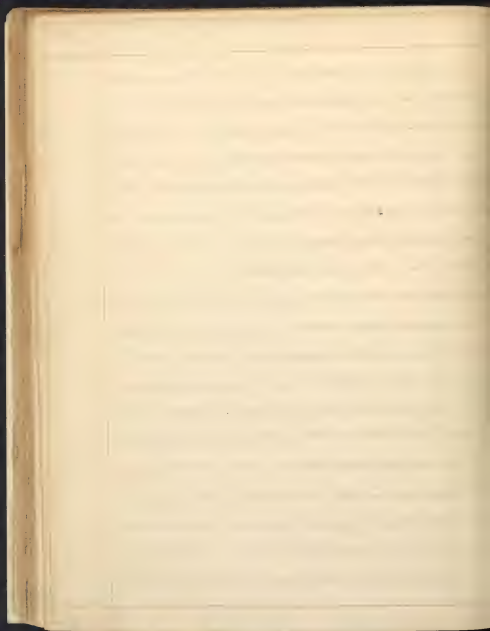


color of the air, for when lead is exposed to the air and kept constantly wet, it is oxidized much more rapidly than it otherwise would be. Hence the reason of the white crust which appears upon the sides of leaden vessels containing water, just at the place where the upper surface of the water terminates.

This oxide is soluble to a certain extent in water and thus unpleasant symptoms may accrue from keeping this fluid intended for drinking in cisterns lined with lead.

Water appears also to act more readily on lead, when impregnated with the neutral salts that are occasionally contained in spring water.

This fact cannot be better illustrated, than by referring to the account given by Dr. Woll (in a letter to Dr. George Baker) of a family residing in the town of Worcester. "A gentleman" (he says) "of this town was the father of a numerous offspring having had one and twenty children, of whom eight died young and thirteen survived their parents. During their infancy and indeed untill they had quitted the place of their usual residence, they were all remarkably weak; being particularly subject to disorders of the stomach and bowels. The father



"during many years was jaundiced. The mother for a long time  
 "subject to attacks and bilious obstructions. She died at last of an  
 "obstinate jaundice. The disease had been several times removed  
 "by the use of Bath water but it always came on again soon  
 "after her return to Leicester; and at last decided every method  
 "and medicine which was tried.

"After the death of the parents, the family sold the house  
 "which they had so long inhabited. The purchaser found it  
 "necessary to repair the pump. This was made of lead which  
 "upon examination, was found to be so corroded that several  
 "fragments were found in the cylinder in which the bucket  
 "goes; and the bottom in the upper part was reduced to the  
 "thickness of common brown paper and was full of holes like a sieve.  
 "The water of the town are remarkably hard, so much so as to  
 "scum soap, coagulate milk, and let fall a copious precipitate  
 "on the addition of an alkali either fixed or volatile, and in dry  
 "seasons its taste is bitter and acrimonious. This water  
 "evidently contains an acid property, which enabled it to act  
 "upon and render soluble a considerable portion of the lead."—



Sulphuric acid has no direct action on lead except when concentrated, and at a boiling temperature. It is then decomposed, and sulphurous acid is formed. The insolubility of lead in sulphuric acid, occasions its being employed as the material for constructing the chambers in which that acid is prepared, and even for boiling down the weak acid. Sulphate of lead however may be formed either by adding sulphuric acid, or what is still better sulphate of soda to any of the salts of lead. Its insolubility renders its formation of use as a step in mineral analysis and hence it is necessary to know its exact composition: which is stated by Berzelius, as follows,

Sulphuric acid . . . . 26.34 . . . . 100

Lead oxide . . . . 73.66 279

379

Nitric acid acts upon lead with considerable energy, provided it be not too much concentrated; first converting it into a white powder, which is a no salutar, and then splitting it especially when assisted by heat. The powder made of lead is dissolved by nitric acid completely, and without effervescence; but the red oxide is rendered white and a portion as I have





before another is, is deposited leaving a precipitate converted into the brown oxide. —

The nitrate of lead is always formed when lead is dissolved in nitric acid, except there be present an excess of lead, and a strong heat be applied; it is formed also by dissolving the carbonate or white lead in nitric acid. The solution is transparent and colourless and when sufficiently concentrated by evaporation, crystallizes on cooling. The crystals are small, tabular, having their apex truncated. They are opaque and white and have a silvery lustre; soluble in  $7\frac{1}{2}$  parts of boiling water; they contain no water of crystallization, and consist according to Berzelius of —

Nitric acid	32.78	100.
Yellow oxide	67.22	209.5

Thomson considers this salt a super nitrate and describes a great coloured scaly salt, which is supposed to be the neutral nitrate consisting of,

Nitric acid	19.86	100.
Yellow oxide	80.14	403.



Nitrate of lead according to Thomson was discovered by Roust;  
 but its true composition was first ascertained by Berzelius &  
 Chevreul, and from their experiments he has stated, "it would  
 appear that there are three sub-species of this salt, the tri-  
 nitrate subnitrate and quadronitrate. The first consists  
 of 1 atom of acid, + 1 atom base, the second 1 atom acid +  
 2 atoms base, and the third 1 atom acid + 3 atoms base.

When a solution of nitrate of lead is boiled upon lead in the  
 metallic state, it forms a subnitrate of this metal; the lead  
 is gradually dissolved, being oxidised at the expense of the  
 acid which partly flies off in the state of nitrous gas, and is  
 partly converted into nitrous acid. If the requisite portion  
 of lead only is dissolved, which according to the experiments  
 of Berzelius amounts to 7.8 parts of lead for every ten parts of  
 nitrate of lead employed, the solution has a yellow colour  
 and deposits subnitrate of lead in scales: but if a greater quan-  
 -tity of lead has been dissolved quadronitrate is likewise formed,  
 and almost the whole is converted into this salt, when as much  
 lead as is possible is dissolved, by boiling on it a solution of nitrate  
 of lead.



The white crystals in hot water, forming a solution in hot water and cooling water, it comes out about a tenth of its weight. It was more pure, according to the result of its analysis that some trials for constituents are

At one trial . . . 11.10 . . . 110

At one trial . . . 31.85 . . . 310

The white crystals in water of which 10 parts of boiling water, dissolves about three parts and returns about one when cooled down to  $73^{\circ}$  of Fahrenheit it consists of,

At one trial . . . 9.4 . . . 110

At one trial . . . 90.1 . . . 910

When the sulfate, or any other soluble salt of lead is mixed to a solution of common salt, a precipitate takes place of white lead. The same compound may be formed by introducing heated lead into chlorine gas; it does not burn but absorbs the gas and is converted into a chloride of lead. It may also be obtained by treating the oxides of lead with nitric acid. When dry the compound is a soft semi-transparent substance; fusible at a heat below redness, and soluble in



under a coat. It has a sweet taste and is soluble in 20 parts  
of clear water. It has received the names of *liver lead*, *minium*  
of *India*, and *jelumbane*; Bergius states its composition to be

mineral acid . . . . .	10.64	100.
yellow oxide . . . . .	89.36	409.00

According to Sir H Davy, it is composed of chlorine with one  
half chloride, or chlorine of lead, composed of -

Chlorine . . . . .	24.63	100.
lead . . . . .	75.38	306

The sub-chloride of lead called *mineral* or *patent yellow*,  
is made by mixing two parts of the red oxide of lead, with one  
of mineral of soda: this mixture is made into a paste  
with water; the common salt is decomposed and a mineral  
or probably sub-mineral of lead is formed; which on fusion  
affords this substance. The soda is disengaged and attracts  
carbonic acid from the atmosphere, but not enough to convert  
it into a carbonate. —

A compound of lead with phosphorus may be formed, by mixing  
together equal parts of filings of lead and phosphorus acid.





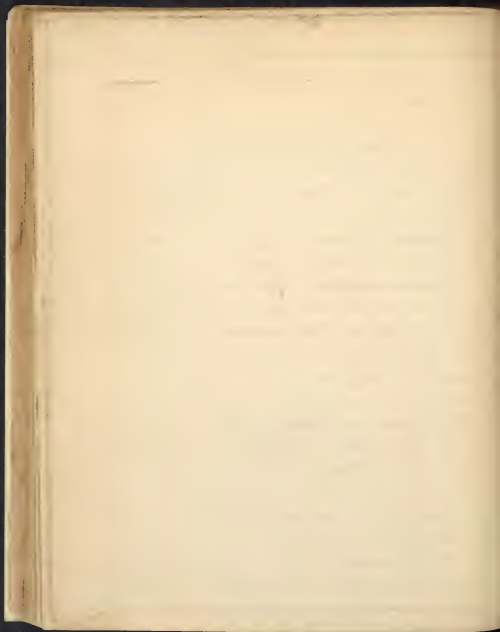
It is a white powder with a shade of blue, may be cut with a knife, but is brittle under the hammer. —

The same substance may be formed by bringing phosphorus in contact with molten lead. According to Pelletier, it consists of 88 parts of lead and 12 of phosphorus.

Having, preceded thus far in my account of the preparations of lead, I shall now mention a combination which though manufactured in quantities much greater than the others is almost exclusively applied to purposes appertaining to the art, being seldom (or not at all) resorted to as a chemical article in the practice of medicine; though it may be employed in the formation of combinations exceedingly poisonous both to the Physician and Surgeon it is the

Mineral Sub-carbonate or white Lead.

The composition of this substance has not until lately been well understood, and hence arose a diversity of applications; but to Berzelius the credit has been attributed of having discovered it to be a carbonated oxide of lead and not an acetate, or sub-acetate though the action and is the

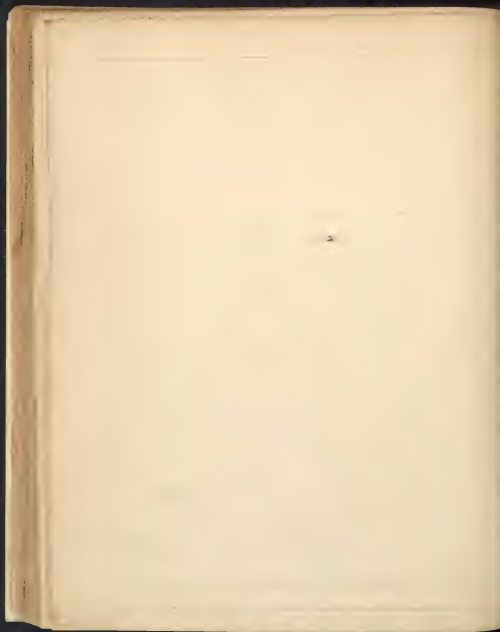


means of its generation, by action, upon the metal and thus producing an oxide with which oxide the carbon and generated by the decomposing vegetable matter (in which the lime is placed) gradually reacts, until the whole is thus formed into a sub-carbonate.

It is also probable (as has been suggested to me by my Brother Mr John P Westlake) that in the action and decomposition, the portion of carbon which is contained, may be afforded to the oxide, leading greatly to accelerate the process.

But as the plan adopted for the manufacture of canvas in this country, differs in some respects from that recommended by authors and pursued in Europe, I feel myself obliged to dwell more particularly and enter more fully into the process made necessary for its preparation.

I read a metal and cast so as to form a sheet about two feet and a half long and five or six inches in breadth, being from  $\frac{1}{40}$  to  $\frac{1}{100}$  of an inch in thickness. The cast in this instance is cast at once of the proper form and not merely characterly flattened as sheet lead usually is. By this plan the texture of the metal is rendered more open and more

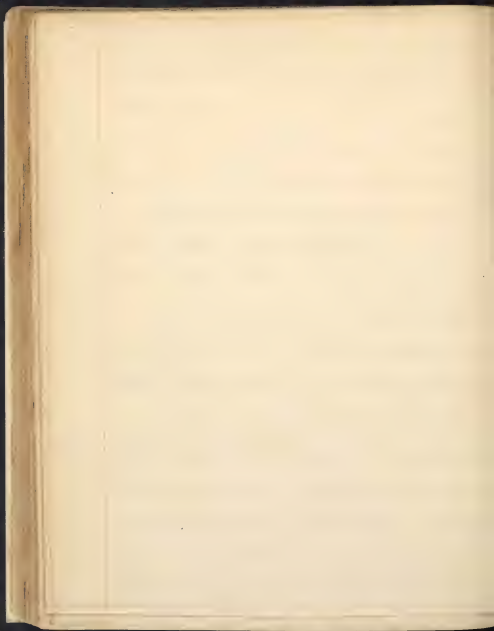


easily penetrated by the acid vapours. These plates are then rolled up into loose coils and each is placed perpendicularly in an earthen pot, usually found, very large enough usually to contain the coil with having on its inner surface projections which prevent its coming in contact with the bottom of the pot; and which projections also answer the purpose of allowing a considerable portion of vinegar (which is to be poured in them) to be contained, without swelling the lower part of the lead.

These pots are then ranged in rows, as they are called) under a building that shelters them from the weather, layer upon layer, being covered with boards and having intervening between each layer, fresh stable litter.\*

The heat of the dung acting upon the vinegar causes it to evaporate, and the lead kept constantly in contact with the acid vapour but not immersed in the liquid, soon begins to corrode or oxidate.

The pots remain under the litter for about six weeks or less usually, at the end of which time they are taken out and the coils are

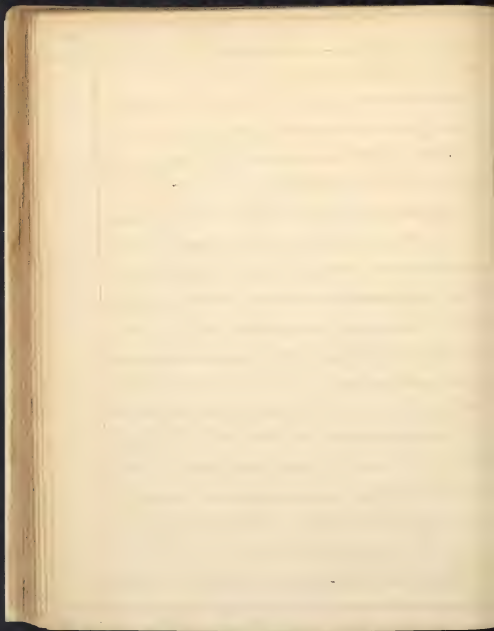


Lutite sub-carbonate -

But as the section represents the whole and is not equivalent  
we generally have small portions of the section which have not  
been acted upon by the section and which thus escape corrosion;  
these are to be carefully separated by means of a prism.

This sub-carbonate, is mixed with water and passed between a pair of mill stones; the finer parts are separated from the coarser by successive washings, or rather by letting the water in which this preparation is suspended flow through sieves, the fine particles pass off, whilst those which by grinding have not been rendered sufficiently so deposit in the first calan, and are again ground - The finer part being more readily suspended in water is deposited in the last calan; this is to be well levigated and after the <sup>impurities a</sup> coarse has sufficiency of the water is drawn off to render it fit for using; it is then placed upon tiles and by a gradual fire the water is evaporated from it; when this is effected it then constitutes ceruse or the white lead of commerce.

As I have in the preceding pages, made particular mention





of the red, yellow, and pure coloured oxides of lead, (which have usually been mentioned by authors in this paper) I shall continue my subject by calling the attention of my readers to a preparation entitled,

*Plumbi Oxidum semivitreum* or *Litharge*. -

This preparation, according to Thomson is the yellow oxide combined with four per cent of carbonic acid; to form it, massicot is usually thrown into a furnace; the heat being increased suddenly and to a great degree, it melts and has somewhat the appearance and consistency of ore and on cooling, concretes into this substance, the carbonic acid being derived from the carbonaceous matter burnt in the flame of the furnace.

Litharge is also formed during the extraction of silver from lead. Its colour is yellow, varying in degree according to the heat of the fire to which it has been exposed. -

The uses for which it has been employed in Pharmacy are for making plasters as the Emplast. Plumbi, and *Unguentum Saponis*.

It is also used for the formation of Goulard's extract.

*Lithargis*.

This (as well as other preparations of lead) is sometimes fraudulently



added to cyder or the inferior French wines, to remove or prevent acidity. This deleterious adulteration may be detected (as may all other solutions of lead) by sulphuretted hydrogen water, which will throw down the lead in the state of a dark brown sulphuret.

Be no carbonate of ammonia, which is a more ancient but may be employed to precipitate the lead in the form of a white carbonate, which on being washed and digested with sulphuretted hydrogen water, will constantly become black: this holds on charcoal before the blow pipe, and gives a globule of lead.

Chromate of potash will also throw down from all saturnine solutions a beautiful orange yellow precipitate.

Decaymate of potash occasions a white precipitate, as also does gallic acid and infusion of sand galls. —

A pint of wine kept in a solution of lead occasions either a white precipitate, or the lead appears in its natural state.

Saturnine adulteration may however be more positively ascertained by evaporating the suspicious liquor to a thick <sup>and charged</sup> consistency, and calcine in a crucible: in the space of an hour



sublimed points will be obtained, consisting of lead surrounded  
by a quantity of yellow oxide. —

I will continue my account by mentioning another preparation  
of lead which though of use in the arts, is considered as a  
remedial article to be of greater utility to the Physician than  
any of those heretofore spoken of, I allude to the

*Plumbi Acetas. Super Acetate of Lead. Saccharum saturni.*  
*vulgo Sugar of Lead.*

The recipe recommended in our dispensatories for the prepa-  
ration of this article is to take of

Sub-carbonate of lead — — — — any quantity,

" Purified Vinegar — — — — ten times its weight

" Digest these in a glass vessel untill the vinegar becomes sweet,

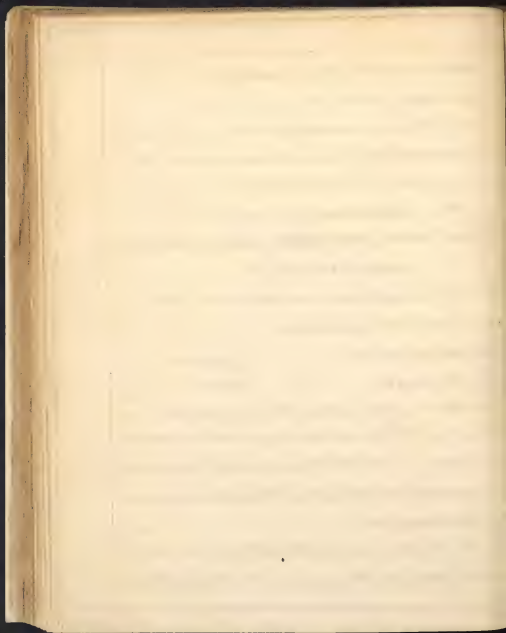
" having poured this off add more vinegar untill it ceases to

" become sweet. Filter the liquor and crystallize by attenuating

" slow evaporation and refrigeration. The crystals are to be dried

" in the shade. —

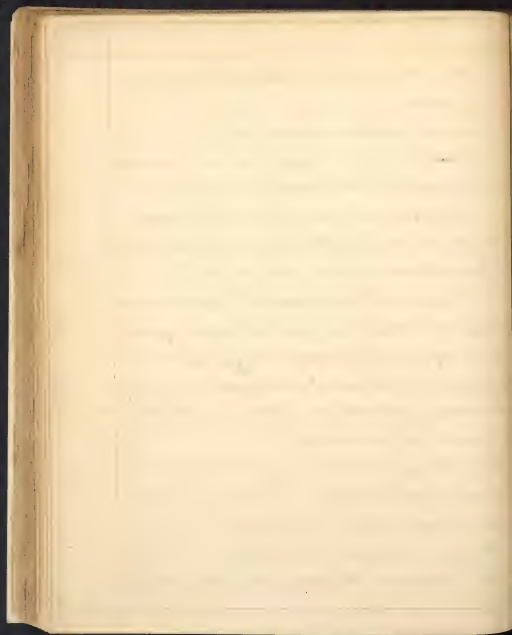
But the process for forming this article as I have seen it  
presently differs from the foregoing and is attended with much



best known; the quality of the preparation when made in any  
equally good.

Instead of using the sub carbonate of lead as usual; <sup>manufacturers</sup> have found it preferable to use the metal itself,  
which is prepared for the purpose by being poured whilst  
in a molten state into water; this forms it into detached  
pieces of a loose texture; these pieces are then collected and placed  
in tubs. Purified vinegar is poured upon them and suffers  
to remain for sometime, until it has acquired a sweet  
taste; it is then drawn off and after evaporating until  
it has acquired a sufficient consistency suffers to  
crystallize. This process by adding fresh vinegar may  
be continued until the whole of the lead in the tubs is  
taken up by acetic acid.

next; the sugar of lead used in England is imported from  
Holland. In that country it is formed very nearly in the  
manner of Canada; that is, sheets of lead are put in pots  
with vinegar and digested a sufficient time; but here the  
vinegar is distilled and the plates instead of being entirely





out of the liquor are half immersed in it. This being done the upper half is soon covered with an efflorescence of crystals, after which it is immersed in the mercury and the part which was before immersed is now brought up to be converted into crystals as before, when the plate is again turned, and the newly oxidated surface in its turn buried in the liquor.

When prepared by either of the methods, which I have considered, it consists of irregular masses resembling lumps of white sugar; being an aggregation of circular four sided prisms terminated by dihedral summits, which are slightly efflorescent. This salt has an astringent sweetish taste; the specific gravity is 2.54 and without an excess of acid it will not be rendered soluble in less than 25 parts of water; when dissolved in water a white powder is deposited, which is a carbonate of lead formed by the carbonic acid contained in the water; and the same salt is thrown down by blowing a current of air from the lungs into the solution.

When dry acetate of lead is briskly heated without addition in a retort, it gives out an acridous red fuming liquor, and



The residue of the distillation forms a gray pyrophorus.

But Roust in distilling it very slowly obtains first a watery vinegar, then a yellow liquid with the smell of alcohol but rather empyreumatic, from which when saturated with potash a strong, smelly, ætherial oil separates.

The liquid distilled from the solution furnishes a strong inflammable fluid resembling ether. —

To continue my account of the preparations of lead I will mention a combination of Litharge and strong vinegar introduced into practice many years ago by a French surgeon of Montpellier, named Goulard, which he called Extract of Saturn but which since his time has acquired different appellations, as, Goulard's extract. Aqua Lithargyæ et Acetici and Extract of Lead.

To obtain this preparation, it is necessary to take of the ingredients, in the proportions of —

Litharge . . . . . one pound

Strong vinegar . . . . . two pints

Put them together into a glazed earthen ware pipkin

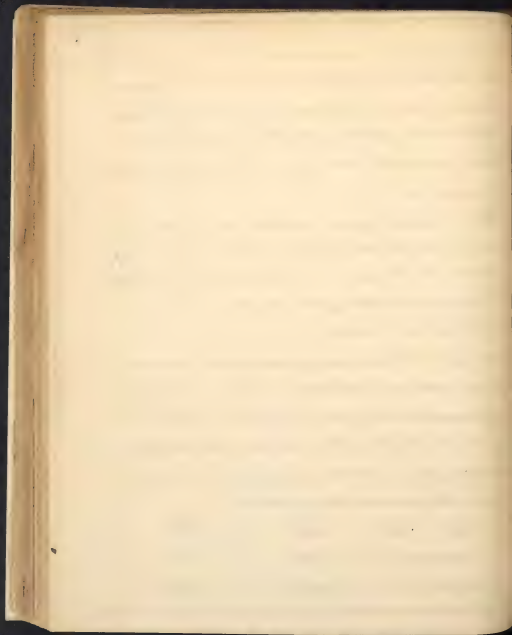


and let them boil or rather simmer, for an hour or an hour and a quarter, taking care to stir them all the while with a wooden spatula. After the wine has stood to settle pour off the clear liquor which is upon the top for use. —

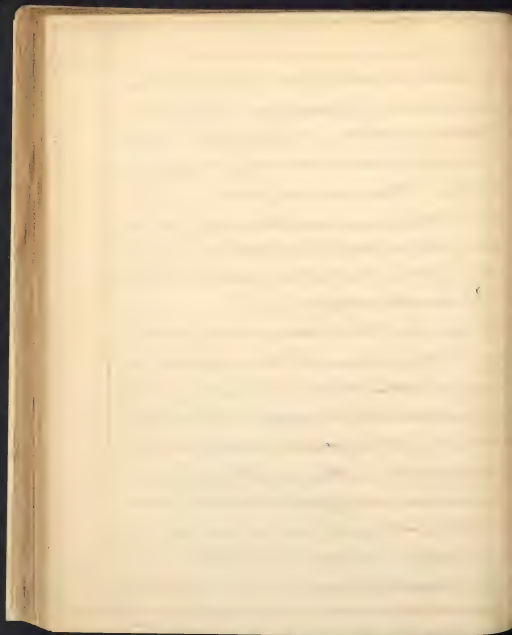
This is Rousseau's original preparation it is of a straw colour with a slight admixture of green and has the specific gravity of 1.22. One hundred drops of this with four teaspoonfuls of brandy mixed with a quart of water form his famous singls mineral water.

Dr Cope in his Dispensary, mentions this preparation (on the authority of Dr Boerhaave) as differing from acetate of lead only in the different proportions of the same ingredients, "thus" (says he) in the saturated solution of "the sugar of lead and the water of acetated litharge, it appears the constituents, are respectively

"Oxide of lead . . . . .	<sup>anhydrous</sup> 10.8	<sup>hydrated</sup> 23.1
"Acetic Acid . . . . .	7.5	5.
"Water . . . . .	75.7	71.9



The author just quoted has also mentioned that "Berzelius obtained the salt in crystallized plates by boiling 100 parts of litharge in a solution of 100 parts of sugar of lead; and upon analysing it found it to consist of 47 and 78 of acid and water. These experiments, the consequences of which confirm their accuracy, show that in sugar of lead 100 parts of acid are combined with 224 parts of oxide of lead, and in goulard's extract with 450 or 460 or somewhat more than twice the quantity of oxide. — Below according to the doctrine of definite proportions, every acid always combines with the same proportion of oxygen or of gas, whatever the proportion of metal may be: it is therefore evident that the oxygen in the oxide of lead, contained in goulard's extract, is combined with base as much as it is in the oxide of the sugar of lead; or goulard's extract is the acetate of the peroxide of lead. Another preparation formed from that just mentioned which is the last I shall consider, is then, *Liquor subacutus Lythgyri compositus*. Compound liquor





of acetated litharge its form it you take of

Liquor of acetated litharge . . . . . a measure

Distilled water . . . . . fourteen ounces

Weaker sp. of wine . . . . . a measure

Mix the spirit and liquor of acetated litharge then  
add the distilled water. —

*Genis*

